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Earth Atmospheric Science
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Research Scientist
NASA Jet Propulsion Laboratory

Professional Experience

2014-present: **Research Scientist 3** at the NASA Jet Propulsion Laboratory, California Institute of Technology, **Adjunct Assistant Professor** at the Meteorology Department of the Pennsylvania State University

2011-2014: **Research associate** at the Meteorology Department of the Pennsylvania State University, member of the Graduate Faculty.

2012-present: **Co-founder** of CarbonNowCast (State college, PA), LLC

2009-2011: **Post Doctoral Researcher** at the Meteorology Department of the Pennsylvania State University, to evaluate current inventories with a mesoscale inverse system in the Mid Continent Intensive Project, with Pr Kenneth J. Davis

Education

Ph.D. (2005-2008) in Meteorology at the Laboratoire des Sciences du Climat et de l'Environnement (LSCE) and Meteo France under the supervision of Pr Peter Rayner and Dr Joel Noilhan

Title: Mesoscale inversion of carbon sources and sinks (EU FP7 CarboEurope project)

M.S.: Oceans, Atmosphere, and Continental Surfaces, Meteo France, Toulouse, France

B.S.: Geology and Geophysics, University of Montpellier 2 (France)

Publications

Turnbull, J., C. Sweeney, A. Karion, T. Newberger, P. Tans, S. Lehman, K.J. Davis, N.L. Miles, S.J. Richardson, **T. Lauvaux**, M.O. Cambaliza, P. Shepson, K. Gurney, R. Patarasuk, A.

Zondervan: Towards quantification and source sector identification of fossil fuel CO₂ emissions from an urban area: Results from the INFLUX experiment. *J. Geophys. Res. Atmos.*, doi: 10.1002/2014JD022555, 2015.

Cambaliza MOL, Shepson PB, Bogner J, Caulton DR, Stirm B, C. Sweeney, S. A. Montzka, K. R. Gurney, K. Spokas, O. E. Salmon, T. N. Lavoie, A. Hendricks, K. Mays, J. Turnbull, B. R. Miller, **T. Lauvaux**, K. J. Davis, A. Karion, et al. - Quantification and source apportionment of the methane emission flux from the city of Indianapolis. *Elem. Sci. Anth.* 3: 000037 doi: 10.12952/journal.elementa.000037, 2015

Díaz Isaac, L. I., **T. Lauvaux**, K. J. Davis, N. L. Miles, S. J. Richardson, A. R. Jacobson, and A. E. Andrews (2014), Model-data comparison of MCI field campaign atmospheric CO₂ mole fractions, *J. Geophys. Res. Atmos.*, 119, doi:[10.1002/2014JD021593](https://doi.org/10.1002/2014JD021593).

Cambaliza, M. O. L., Shepson, P. B., Caulton, D. R., Stirm, B., Samarov, D., Gurney, K. R., Turnbull, J., Davis, K. J., Possolo, A., Karion, A., Sweeney, C., Moser, B., Hendricks, A., **Lauvaux, T.**, Mays, K., Whetstone, J., Huang, J., Razlivanov, I., Miles, N. L., and Richardson, S. J.: Assessment of uncertainties of an aircraft-based mass balance approach for quantifying urban greenhouse gas emissions, *Atmos. Chem. Phys.*, 14, 9029–9050, doi:10.5194/acp-14-9029-2014, 2014.

Lauvaux, T., and K. J. Davis (2014), Planetary boundary layer errors in mesoscale inversions of column-integrated CO₂ measurements, *J. Geophys. Res. Atmos.*, 119, 490–508, doi:[10.1002/2013JD020175](https://doi.org/10.1002/2013JD020175).

T. Lauvaux, A Deng, B Gaudet, C Sweeney, G Petron, A Karion, A Brewer, M Hardesty, S Herndon, T Yacovitch, S Conley: Quantification of methane sources in the Barnett shale (Texas) using the Penn State WRF-Chem-FDDA realtime modeling system, 14th WRF Users' Workshop, extended abstract, 2013.

T. Lauvaux, N.L. Miles, S.J. Richardson, A. Deng, D. Stauffer, K.J. Davis, G. Jacobson, C. Rella, G.-P. Calonder: Urban emissions of CO₂ from Davos, Switzerland: the first real-time monitoring system using an atmospheric inversion technique, *Journal of Applied Meteorology and Climatology*, doi: <http://dx.doi.org/10.1175/JAMC-D-13-038.1>, 2013.

Wu, L., Bocquet, M., Chevallier, F., **Lauvaux, T.**, & Davis, K. (2013). Hyperparameter estimation for uncertainty quantification in mesoscale carbon dioxide inversions. *Tellus B*, 65. doi:10.3402/tellusb.v65i0.20894

Schuh, A. E., **Lauvaux, T.**, West, T. O., Denning, A. S., Davis, K. J., Miles, N., Richardson, S., Uliasz, M., Lokupitiya, E., Cooley, D., Andrews, A. and Ogle, S.: Evaluating atmospheric CO₂ inversions at multiple scales over a highly inventoried agricultural landscape. *Global Change Biology*, 19: 1424–1439. doi: 10.1111/gcb.12141, 2013

Cooley D., Breidt F.J., Ogle S.M., Schuh A., **Lauvaux T.**: A Constrained Least-Squares Approach to Combine Bottom-Up and Top-Down CO₂ Flux Estimates. *Environmental and Ecological Statistics*, doi: 10.1007/s10651-012-0211-6, 2012.

A. Deng, **T. Lauvaux**, K. Davis, N. Miles, S. Richardson and D. Stauffer: A WRF-Chem Realtime Modeling System for Monitoring CO₂ Emissions., 13th Annual WRF Users' Workshop, Boulder, extended abstract.

Miles, N. L., S. J. Richardson, K. J. Davis, **T. lauvaux**, A. E. Andrews, T. O. West, V. Bandaru, and E. Crosson: Large amplitude spatial and temporal gradients in atmospheric boundary layer CO₂ mole fractions detected with a tower-based network in the U.S. upper Midwest, *J. Geophys. Res.*, 117, G01019, doi:10.1029/2011JG001781., 2012.

T. Lauvaux, Schuh, A.E., Uliasz, M., Richardson, S., Miles, N., Andrews, A.E., Sweeney, C., Diaz, L.I., Martins, D., Shepson, P.B., and Davis, K.J.: Constraining the CO₂ budget of the corn belt: exploring uncertainties from the assumptions in a mesoscale inverse system, *Atmos. Chem. Phys.*, 12, 337-354, doi:10.5194/acp-12-337-2012, 2012.

T. Lauvaux, Schuh, A., Bocquet, M., Wu, L., Richardson, S., Miles, N., & Davis, K.: Network

design for mesoscale inversions of CO₂ sources and sinks. *Tellus B*, 64. doi:10.3402/tellusb.v64i0.17980, 2012.

Wu, L., M. Bocquet, **T. Lauvaux**, F. Chevallier, P. Rayner, and K. Davis (2011), Optimal representation of source-sink fluxes for mesoscale carbon dioxide inversion with synthetic data, *J. Geophys. Res.*, 116, D21304, doi:10.1029/2011JD016198.

T. Lauvaux, B. Gioli, C. Sarrat, P. J. Rayner, P. Ciais, F. Chevallier, J. Noilhan, F. Miglietta, Y. Brunet, E. Ceschia, H. Dolman, J. A. Elbers, Gerbig, R. Hutjes, N. Jarosz, D. Legain, M. Uliasz (2009): Bridging the gap between atmospheric concentrations and local ecosystem measurements, **Geophys. Research Lett.**, , 36, L19809, doi:10.1029/2009GL039574. (cited: 13)

T. Lauvaux, O. Pannekoucke, C. Sarrat, F. Chevallier, P. Ciais, J. Noilhan, and P. J. Rayner: Structure of the transport uncertainty in mesoscale inversions of CO₂ sources and sinks using ensemble model simulations, **Biogeosciences**, 6, 1089-1102, 2009. (cited: 11)

Sarrat, C., Noilhan, J., Lacarrere, P., Donier, S., Dolman, A., Gerbig, C., Hutjes, R., Elbers, J., Gioli, B., Miglietta, F., Neininger, B., **Lauvaux, T.**, Ciais, P., Ramonet, M., Ceschia, E., Bonnefond, J. M.: Mesoscale modeling of the CO₂ interactions between the surface and the atmosphere applied to the April, 2007 CERES field experiment, **Biogeosciences**, 6, 633-646, 2009. (cited: 10)

T. Lauvaux, M. Uliasz, C. Sarrat, F. Chevallier, P. Bousquet, C. Lac, K. J. Davis, P. Ciais, A. S. Denning, P. Rayner, Mesoscale inversion: first results from the CERES campaign with synthetic data, **Atmospheric Chemistry and Physics**, 8, 3459-3471, 2008. (cited: 31)

Books

Dolman, A.J., Noilhan, J., Tolk, L., **Lauvaux, T.**, van der Molen, M., Gerbig, C., Miglietta, F., Pérez-Landa, G., 2007. Regional measurements and modeling of carbon exchange. In: Dolman, H., Valentini, R., Freibauer, A. (Eds.), Observing the continental scale Greenhouse Gas Balance of Europe. **Ecological Studies of Springer (book)**.

Selected Conferences

Lauvaux, Deng, Davis, Wu, Richardson, Miles, Sarmiento, Gurney, Patarasuk. Urban inversion of greenhouse gases at high resolution during the dormant season over Indianapolis. Abstract submitted for the 5th North American Carbon Program Principal Investigators Meeting, Washington, D.C., January 2015.

Gaudet, Lauvaux, Deng, Davis. Evaluating regional model transport uncertainty using realistic LES simulations. Poster presented at the 5th North American Carbon Program Principal Investigators Meeting, Washington, D.C., January 2015.

Wu, Davis, Lauvaux, Miles, Richardson, Deng, Gaudet, Sarmiento. Sensitivity of flux accuracy to setup of fossil fuel and biogenic CO₂ inverse system in an urban environment. Poster presented at the 5th North American Carbon Program Principal Investigators Meeting, Washington, D.C.; January 2015.

Heimbigner, Cambaliza, Shepson, Shang, Stirm, Hardesty, Brewer, Davis, Lauvaux. Improving and assessing aircraft-based greenhouse gas emission fluxes as part of INFLUX. Poster A53L-3377 presented at the 2014 Fall AGU Meeting, San Francisco, CA; December 2014.

Lamb, Prasad, Cambaliza, Shepson, Stirm, Salmon, Lavoie, Lauvaux, Ferrara, Howard, Edburg,

Whetstone. Assessing the gap between top-down and bottom-up measured methane emissions in Indianapolis, IN. Poster A53M-3387 presented at the 2014 Fall AGU Meeting, San Francisco, CA; December 2014.

Hardesty, Brewer, Shepson, Cambaliza, Salmon, Heimburger, Davis, Lauvaux, McGowan, Miles, Richardson, Sarmiento, Karion, Sweeney, Iraci, Hillyard, Podolske, Gurney, Razlivanov, Song, Turnbull, Whetstone, Possolo, Prasad. One year of Doppler lidar observations characterizing boundary layer wind, turbulence, and aerosol structure during the Indianapolis Flux Experiment. Poster A51O-03 presented at the 2014 Fall AGU Meeting, San Francisco, CA; December 2014.

Whetstone, Davis, **Lauvaux**, McGowan, Miles, Richardson, Sarmiento, Cambaliza, Shepson, Karion, Hardesty, Sweeney, Iraci, Gurney, Turnbull. Measuring CO₂ and CH₄ emissions from Indianapolis: A test bed for urban greenhouse gas emissions monitoring. Poster presented at the American Geophysical Union Science Policy Conference, Washington, DC; 24-26 June 2013.

Turnbull, Cambaliza, Sweeney, Karion, Newberger, Tans, Lehman, Davis, Miles, Richardson, **Lauvaux**, Shepson, Gurney, Song, Razlivanov. Quantification of urban fossil fuel CO₂ emissions from the Indianapolis Flux Project (INFLUX). Presented at the 9th International Carbon Dioxide Conference, Beijing, China; June 3-7, 2013.

Miles, Cambaliza, Davis, Hardesty, Iraci, Gurney, Karion, **Lauvaux**, McGowan, Richardson, Sarmiento, Shepson, Sweeney, Turnbull, Whetstone. On network design for the detection of urban greenhouse gas emissions: Results from the Indianapolis Flux Experiment (INFLUX). Presented at the 9th International Carbon Dioxide Conference, Beijing, China; June 3-7, 2013.

Turnbull, Cambaliza, Sweeney, Karion, Newberger, Tans, Lehman, Davis, Miles, Richardson, **Lauvaux**, Shepson, Guenry, Song, Razlivanov. Quantification of fossil fuel CO₂ emissions from the Indianapolis Flux Project (INFLUX): Can total CO₂ measurements be used as a proxy for fossil fuel CO₂? Poster presented at the 2013 Annual NOAA GMD Conference, NOAA ESRL, Boulder, CO; May 21-22, 2013.

Cambaliza, Shepson, Stirm, Caulton, Miller, Hendricks, Moser, Karion, Sweeney, Turnbull, Davis, **Lauvaux**, Richardson, Miles, Crosson, Prasad, Whetstone. Methane emission flux from Indianapolis, IN: Identification and contribution of sources to the total citywide emission. Presented at the 2013 annual NOAA GMD Conference, NOAA ESRL, Boulder, CO; May 21-22, 2013.

2012 Fall AGU Meeting, San Francisco (selected contributions):

On the use of remote sensing measurements in regional inversions of carbon sources and sinks, **T. Lauvaux**, K.J. Davis, S. Richardson, N. Miles, L.I. Diaz.

Quantifying Methane Emissions from Shale Gas Wells in Pennsylvania, D. Caulton, P. Shepson, M. O. L. Cambaliza, J. P. Sparks, R. Santoro, C. Sweeney, K. J. Davis, **T. Lauvaux**, R. Howarth, B. Stirm, D. Sarmiento, S. Belmecheri

Continuous Monitoring of CH₄ Emissions from Marcellus Shale Gas Extraction in South West Pennsylvania Using Top Down Methodology, D. P. Sarmiento, S. Belmecheri, **T. Lauvaux**, T. A. Sowers, S. Bryant, N. L. Miles, S. Richardson, J. Aikins, C. Sweeney, G. Petron, K. J. Davis

Quantification of fossil fuel CO₂ emissions at the urban scale: Results from the Indianapolis Flux Project (INFLUX) (Invited), J. C. Turnbull, M. O. L. Cambaliza, C. Sweeney, A. Karion, T. Newberger, P. P. Tans, S. Lehman, K. J. Davis, N. L. Miles, S. Richardson, **T. Lauvaux**, P. Shepson, K. R. Gurney, Y. Song, I. N. Razlivanov

Measurements of Urban Area-Wide CO₂ and CH₄ Fluxes as part of the Indianapolis Flux Experiment (INFLUX) (Invited), P. Shepson, B. Callahan, M. O. L. Cambaliza, K. J. Davis, R. M Hardesty, L. T. Iraci, K. R. Gurney, A. Karion, **T. Lauvaux**, L. E. McGowan, et al.

Towards validation of urban GHG emissions using a very high resolution atmospheric inversion in the Indianapolis Flux Experiment, K. J. Davis, **T. Lauvaux**; L. E. McGowa, M. O. L. Cambaliza, R. M Hardesty, L. T. Iraci, K. R. Gurney, P. W. Hillyard, A. Karion, N. L. Miles, J. R. Podolske, I. N. Razlivanov, S. Richardson, D. Sarmiento, P. Shepson, Y. Song, C. Sweeney, J. C. Turnbull, J. R. Whetstone

NOAA GMD Annual Meeting 2012, Boulder: Network Designs for Regional CO₂ Flux Inversions, T. Lauvaux, K.J. Davis, L. Wu, M. Bocquet, N.L. Miles, S.J. Richardson, A.E. Schuh, L.E. Diaz, T. Hilton, oral presentation.

NOAA GMD Annual Meeting 2012, Boulder: Urban Greenhouse Gas Emissions Monitoring in Davos, Switzerland, Before, During and After the 2012 World Economic Forum Annual Meeting, T. Lauvaux, G. Jacobson, C. Rella, K. Davis, S. Richardson, N. Miles, A. Deng, G. Calonder, M. Ruesch, M. Lehning and P. DeCola, oral presentation.

American Geophysical Union, Fall Meeting 2011 (selected contribution): Emission verification from national to local levels using topdown approaches: sampling strategy and modeling performances, **T. Lauvaux**; L.E. McGowan; K.J. Davis; K.R. Gurney; I. Razlivanov; N.L. Miles; S. Richardson; D. Sarmiento; P.B. Shepson; M.L. Cambaliza; J.C. Turnbull; C. Sweeney; A.E. Schuh; J. Hong; P.J. Rayner, oral presentation.

MACC project conference, Utrecht, The Netherlands, 2011: Applicability of atmospheric inversions of greenhouse gases at high resolution, **T. Lauvaux**, L.E. Diaz, N.L. Miles, S.J. Richardson, A.E. Schuh, A.R. Jacobson, A. Andrews, K.J. Davis, invited talk.

2nd International Conference on Hydrology delivers Earth System Science to Society, Tokyo, Japan, 2010: Regional carbon budget with a high density CO₂ concentration tower network: Mesoscale inversion of CO₂ fluxes at high resolution, **T. Lauvaux**, L.E. Diaz, N.L. Miles, S.J. Richardson, A.E. Schuh, A.R. Jacobson, A. Andrews, K.J. Davis, and C. Sweeney

NASA Terrestrial Ecology Science Team meeting, La Jolla, 2010: Regional carbon budget with a high density concentration tower network: Inversion of CO₂ fluxes in the Mid Continental Intensive project, **T. Lauvaux**, L.E. Diaz, N.L. Miles, S.J. Richardson, A.E. Schuh, A.R. Jacobson, A. Andrews, K.J. Davis.

American Geophysical Union, Fall Meeting 2009: The CarboEurope Regional Experiment Strategy: Assessment of the regional carbon balance using inverse and direct methods (Invited talk), **Lauvaux, T.**; Rascher, U.; Gioli, B.; Hutjes, R.W.; Sarrat, C.; Brunet, Y.; Jarosz, N.; Ceschia, E.; Rayner, P.; Gerbig, C.; Miglietta, F.; Noilhan, J.; Dolman, H.,

YAK Aerosib 2nd Science Meeting, Burduguz, Irkutsk region, Russia, 19-21 June 2007: Toward a mesoscale flux inversion at high resolution in the South West of France, **T. Lauvaux**, C. Sarrat, F. Chevallier, P. Ciais, M. Ulasz, A. S. Denning, P. Rayner

European Geosciences Union 2007, Vienna: Ensemble model simulations : A new tool to assess transport uncertainties in mesoscale inversions of CO₂ sources and sinks, **T. Lauvaux**, K. Davis, C. Sarrat, F. Chevallier, M. Ulasz, C. Lac, P. Bousquet, P. Ciais, J. Noilhan, P. Rayner, Geophysical Research Abstracts, Vol. 9, 06718, 2007

Open Science Conference on the GHG Cycle in the Northern Hemisphere Sissi-Lassithi, Crete, 14-18 November 2006, plenary session: Mesoscale inversion: first results from the CERES campaign with synthetic data, **T. Lauvaux**, C. Sarrat, M. Ulasz, F. Chevallier, J. Noilhan, P. Bousquet, P. J. Rayner.

7th Plinius Conference on Mediterranean Storms, 2005: A 4-year climatology of water vapour field from GPS data associated with heavy precipitation events over Southern France, **Lauvaux, T.**; Ricard, D.; Ducrocq, V.; Masson, F. .

European Geosciences Union Meeting, Nice, 2004: Integrated Water Vapor and gradient monitoring during strong meteorological events: a new tool for nowcasting?, Champollion, C., Masson, F., Walpersdorf, A., Brenot, H., **Lauvaux, T.**, Van Baelen, J., Doerflinger, E. and Collard, P..

Others

Reviewer for: *Atmospheric Chemistry and Physics*, *Atmospheric Environment*, *Biogeosciences*, *Journal of Geophysical Research*, *Geophysical Research Letters*, *QJRMS*, *Nature Climate Change*, *Nature*, *PNAS*, *Elementa*.

Proposal review: NSF, NOAA, Natural Environment Research Council (United Kingdom)

Member: American Geophysical Union, NASA Carbon Monitoring System team

Teaching

Inversion summer class: introduction to inverse modeling techniques, mesoscale modeling, adjoint transport simulations, and Lagrangian Dispersion modeling, June 30 - July 4, 2014, at Yonsei University with Pr Jinkyu Hong.

2014 - present: Zachary Barkley, PSU graduate student student (co-supervisor):
Methane emissions in the Marcellus shale using a high resolution atmospheric inversion system

2013 - present: Kai Wu, PSU graduate student (co-supervisor):
Atmospheric inversion of GHG emissions over Indianapolis area

2010 - present: Liza Evelisse Diaz, PSU Ph.D. student (co-supervisor):
Multi-physics ensemble using WRF and transport error characterization in mesoscale inversions

2012 - present: Caroline Normile, PSU Ph.D. Student (co-supervisor):
North American carbon budget using a mesoscale inversion system

2011-2013: Laura McGowan, PSU Master student (co-supervisor):
Impact of urban surface schemes in the WRF modeling system for GHG applications

Undergraduate students: Remi Dulac (2007-2008, LSCE), Kathryn Wheeler (2014 summer REU in Climate Science at PennState), Brandon Clark (2014, SCRIM geoscience summer program at PennState)